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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/669,135	KOKTA ET AL.	
	Examiner	Art Unit	
	Matthew J. Song	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,11-13,16,19-21,23-26 and 31-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,11-13,16,19-21,23-26 and 31-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/ are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/18/07*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/18/2007 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-5, 11-13, 16, 19-21, 23-26 and 31-34 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for aspect ratios up to 0.59, does not reasonably provide enablement for the entire range for producing a single crystal boule at a process aspect ratio of not less than 0.44. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to aspect ratios greater than 0.44 without an upper limit, the invention commensurate in scope with these claims. The applicant admits that increasing boule size for a give melt/crucible has been found to deteriorate crystal quality, note page 6 of the remarks filed 10/18/2007. Without an upper limit the entire range of the claim cannot produce a single crystal spinel boule because the crystal quality will

deteriorate as the aspect ratio increases. The same arguments apply to all claims because none of the claim have an upper limit.

Claim Objections

4. Claim 33 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 33 depends from 32, however claim 32 already recites all of the limitation of claim 33.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-5, 11-13, 16, 19-20, 23-26, and 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grabmaier et al ("Czochralski Growth of Magnesium-Aluminum Spinel" from IDS filed 4/7/2005) in view of Wachi et al (JP 2001-080989), an English translation and abstract is provided, and in view of Robinson et al (US 3,808,065).

In a method of growing a magnesium aluminate spinel using a Czochralski method, note entire reference, Grabmaier et al teaches a single crystal spinel having a composition $(MgO)(Al_2O_3)$ with a ratio oof $MgO:Al_2O_3=3.2$ (pg 356), this clearly suggests applicant's spinel single crystal boule having a formula $aADxbE_2D_3$ when A is Mg, D is O, and E is Al and a ration b:a greater than 1.5:1. Grabmaier et al also teaches a spinel seed crystal (pg 356). Grabmaier et al also teaches crystals could be sawed unannealed without cracking. Grabmeier et al teaches a melt contained in an iridium crucible (pg 355), this clearly suggests applicant's batch melt in a crucible.

Grabmeier et al is silent to the aspect ratio.

In a method of Czocharalski single crystal growth, note entire reference, Wachi et al teaches the aspect ratio is a result effective variable in a Czochralski process (English Translation [0015]). Wachi et al also teaches producing large diameter compound semiconductor single crystals is the problem to be solved (Abstract), which clearly suggests large diameter crystals are desirable. Wachi et al also teaches a crucible diameter/crystal diameter ratio of 2.2-3.2 (Abstract), which is equivalent to an aspect ratio of 0.3125-0.4545. Overlapping ranges are prima facie obvious (MPEP 2144.05).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Grabmeier et al by optimizing the aspect ratio to be greater than 0.44 in order to maximize the size of the crystal because larger crystals are more desirable, as suggested by Wachi et al.

The combination of Grabmeier et al and Wachi et al does teaches sawing the boule. However, the combination of Grabmeier et al and Wachi et al is silent to the boule is sliced into wafers.

In a method of manufacturing spinel wafers, note entire reference, Robinson et al teaches single crystal spinel boules are sliced into wafers with a diamond saw. Robinson et al also teaches spinel wafers with smooth surfaces are useful as substrates in the electric integrated circuit art (col 1, ln 1-35).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Grabmeier et al and Wachi et al by slicing the single crystal spinel boule into wafers, as taught by Robinson et al, to form substrates useful in the electronic integrated circuit art.

Grabmeier et al teaches pulling a crystal using a Czochralski method. Grabmeier et al is silent to the crystal being single crystalline. The Czochralski method of growth is conventionally used in art as a method of forming single crystal, as evidenced by Cullen et al (US 3,883,313), and the Czochralski method is the method used by applicant to form a single crystal; therefore it is expected that the same process used by applicant and which is conventionally used to produce a single crystal would produce a single crystal. In the alternative, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of

Grabmeier et al and Wachi et al by forming a single crystal boule because single crystals have desirable properties, as evidenced by Robinson et al.

Referring to claims 1-5, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches an unannealed crystal, this clearly suggests annealing is substantially eliminated.

Referring to claim 12-13, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches a ratio of 3.2:1, overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 16, a process aspect ratio of greater than 0.44 would have been obvious to one of ordinary skill in the art at the time of the invention, as discussed previously. The combination of Grabmeier et al, Wachi et al and Robinson et al is silent to the aspect ratio prevents flipping of the crystal orientation. The prevention of flipping of the boule from a [111] orientation to a different orientation is expected to occur because a similar aspect ratio is expected to result in a similar effect.

Referring to claims 19-20, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches a $MgOAl_2O_3$ and a seed crystal (pg 356).

Referring to claim 22, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches a Czochralski method.

Referring to claims 23-26, the combination of Grabmeier et al, Wachi et al and Robinson et al is silent to the cooling rate not less than 50°C/hr. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Grabmeier et al, Wachi et al and Robinson et al by optimizing the cooling rate in order to obtain the claimed cooling rate by conducting routine experimentation because faster cooling rates will increase productivity.

Referring to claim 32-34, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches spinal boules of about 3 inches ('065 col 1, ln 5-35). In regards to the aspect ratio of not less than 0.52 or not less than 55, the combination of Grabmeier et al, Wachi et al and Robinson et al teaches aspect ratio is a result effective variable and larger diameter crystals are desirable; therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Grabmeier et al, Wachi et al and Robinson et al by optimizing the aspect ratio to obtain an aspect ratio within the claimed range to produce a large diameter crystal.

7. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grabmaier et al ("Czochralski Growth of Magnesium-Aluminum Spinel" from IDS filed 4/7/2005) in view of Wachi et al (JP 2001-080989), an English translation and abstract is provided, and in view of Robinson et al (US 3,808,065) as applied to claims 1-5, 11-13, 16, 19-20, 23-26, and 31-34 above, and further in view of Li (US 5,968,267).

The combination of Grabmeier et al, Wachi et al and Robinson et al teach all of the limitations of claim 21, as discussed previously, except rotating the crucible.

In a Czochralski method of crystal growth, note entire reference, Li teaches its is common practice is a Czochralski process to rotate the seed about its longitudinal axis during the pulling process in order to grow a crystal with a more uniform cross section and the crucible holding the melt may also be rotated to grow a crystal with a more uniform cross section (col 2, ln 35-65).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Grabmaier et al and Robinson et al by rotating the rotating the crucible, as taught by Li, to grow a crystal with a more uniform cross section.

8. Claims 1-5, 11-13, 16, 19-20, 23-26, and 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cullen et al (US 3,883,313) in view of Wachi et al (JP 2001-080989), an English translation and abstract is provided, and in view of Robinson et al (US 3,808,065).

In a method of growing a magnesium aluminate spinel using a Czochralski method, note entire reference, Cullen et al teaches a single crystal spinel having a composition $(MgO)(Al_2O_3)_x$ where x can be between 1 and 2.3 (Abstract), this clearly suggests applicant's spinel single crystal boule having a formula $aADxbE_2D_3$ when A is Mg, D is O, and E is Al and a ration b:a greater than 1.5:1 because overlapping ranges are held to be obvious. Cullen et al also teaches a spinel seed crystal with a desired orientation of (111) or (100) (col 2, ln 35-67). Cullen et al also teaches boules having a diameter of about 2 inches can be pulled (col 3, ln 50-67).

Cullen does not specifically teach an aspect ratio of greater than 0.44.

In a method of Czocharalski single crystal growth, note entire reference, Wachi et al teaches the aspect ratio is a result effective variable in a Czochralski process (English Translation [0015]). Wachi et al also teaches producing large diameter compound semiconductor single crystals is the problem to be solved (Abstract), which clearly suggests large diameter crystals are desirable. Wachi et al also teaches a crucible diameter/crystal diameter ratio of 2.2-3.2 (Abstract), which is equivalent to an aspect ratio of 0.3125-0.4545. Overlapping ranges are prima facie obvious (MPEP 2144.05).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Cullen et al by optimizing the aspect ratio to be greater than 0.44 in order to maximize the size of the crystal because larger crystals are more desirable, as taught by Wachi et al. Furthermore, Figure 1 of Cullen suggests a large aspect ratio because the crystal is approximately the size of the crucible.

The combination of Cullen et al and Wachi et al is silent to the boule is sliced into wafers.

In a method of manufacturing spinel wafers, note entire reference, Robinson et al teaches single crystal spinel boules are sliced into wafers with a diamond saw. Robinson et al also teaches spinel wafers with smooth surfaces are useful as substrates in the electric integrated circuit art (col 1, ln 1-35).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Cullen et al and Wachi et al by slicing the single crystal spinel boule into wafers, as taught by Robinson et al, to form substrates useful in the electronic integrated circuit art.

Referring to claims 1-5, the combination of Cullen et al, Wachi et al and Robinson et al does not teach annealing the crystal, this clearly suggests annealing is substantially eliminated.

Referring to claim 12, the combination of Cullen et al, Wachi et al and Robinson et al teaches a ratio of 2.3:1. (MPEP 2144.05).

Referring to claim 13, the combination of Cullen et al, Wachi et al and Robinson et al al teaches a ratio of 2.3:1. The combination of Cullen et al, Wachi et al and Robinson et al does not teach a ratio of greater than 2.5:1. It would have been obvious to a person of ordinary skill in the

art at the time of the invention to modify the combination of Cullen et al, Wachi et al and Robinson et al by changing the composition to obtain the claimed composition because changes in concentration are held to be obvious (MPEP 2144.05) and ratios of up to 3.2:1 are known in the art to result in mechanically stable crystals, as evidenced by Grabmeier et al ("Czochralski Growth of Magnesium-Aluminum Spinel").

Referring to claim 16, a process aspect ratio of greater than 0.44 would have been obvious to one of ordinary skill in the art at the time of the invention, as discussed previously. The combination of Cullen et al, Wachi et al and Robinson et al is silent to the aspect ratio prevents flipping of the crystal orientation. The prevention of flipping of the boule from a [111] orientation to a different orientation is expected to occur because a similar aspect ratio is expected to result in a similar effect.

Referring to claims 19-20, the combination of Cullen et al, Wachi et al and Robinson et al teaches $MgOAl_2O_3$ and a seed crystal (pg 356).

Referring to claims 23-26, the combination of Cullen et al, Wachi et al and Robinson et al is silent to the cooling rate not less than 50°C/hr. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Cullen et al, Wachi et al and Robinson et al by optimizing the cooling rate in order to obtain the claimed cooling rate by conducting routine experimentation because faster cooling rates will increase productivity.

Referring to claims 32-34, the combination of Cullen et al, Wachi et al and Robinson et al teaches spinal boules of about 2 inches ('313 col 3, ln 60-67). In regards to the aspect ratio of not less than 0.52 or not less than 55, the combination of Cullen et al, Wachi et al and Robinson et al

teaches aspect ratio is a result effective variable and larger diameter crystals are desirable; therefore it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Cullen et al, Wachi et al and Robinson et al by optimizing the aspect ratio to obtain an aspect ratio within the claimed range to produce a large diameter crystal.

9. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cullen et al (US 3,883,313) in view of Wachi et al (JP 2001-080989), an English translation and abstract is provided, and in view of Robinson et al (US 3,808,065) as applied to claims 1-5, 11-13, 16, 19-20, 23-26, and 31-34 above, and further in view of Li (US 5,968,267).

The combination of Cullen et al, Wachi et al and Robinson et al teach all of the limitations of claim 21, as discussed previously, except rotating the crucible.

In a Czochralski method of crystal growth, note entire reference, Li teaches its is common practice is a Czochralski process to rotate the seed about its longitudinal axis during the pulling process in order to grow a crystal with a more uniform cross section and the crucible holding the melt may also be rotated to grow a crystal with a more uniform cross section (col 2, ln 35-65).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Cullen et al, Wachi et al and Robinson et al by rotating the rotating the crucible, as taught by Li, to grow a crystal with a more uniform cross section.

Response to Arguments

10. Applicant's arguments with respect to claims 1-5, 11-13, 16, 19-21, 23-26 and 31-34 have been considered but are moot in view of the new ground(s) of rejection.

11. Applicant's arguments filed 10/18/2007 have been fully considered but they are not persuasive.

Applicant's argument that the prior art does not teach optimizing the process aspect ratio to achieve large crystals is noted but not found persuasive. Wachi et al clearly teaches controlling the ratio of the crystal diameter to the crucible diameter to solve the problem of producing large diameter crystals using the Czochralski method of crystal growth (Abstract).

Applicant's argument that Wachi does not have any relevance to the growth of spinel crystal is noted but not found persuasive. Wachi et al teaching are directed to Czochralski single crystal growth. Grabmaier or Cullen, the primary references, teach Czochralski method crystal growths. A person of ordinary skill in the art would realize that the teaching about Czochralski crystal growth are combinable. The Wachi et al reference is merely relied upon for its broad teaching regarding the Czochralski growth process, not the material of growth, which is taught by Cullen or Grabmaier.

Applicant's argument that an aspect ratio of 0.44 is non-obvious is noted but not found persuasive. Wachi et al clearly teaches a range of 0.3125-0.4545, which overlaps the claimed range. Overlapping ranges are prima facie obvious (MPEP 2144.05). Thus the use of an aspect ratio greater than 0.44 for a Czochralski crystal growth process would have been obvious to one ordinary skill in the art.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Barr can be reached on 571-272-1414. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
January 3, 2008

/Robert Kunemund/
Robert Kunemund
Primary Examiner
TC 1700